

FIG. 1 is a schematic diagram of a process for the production of hydrogen gas from iron ore.

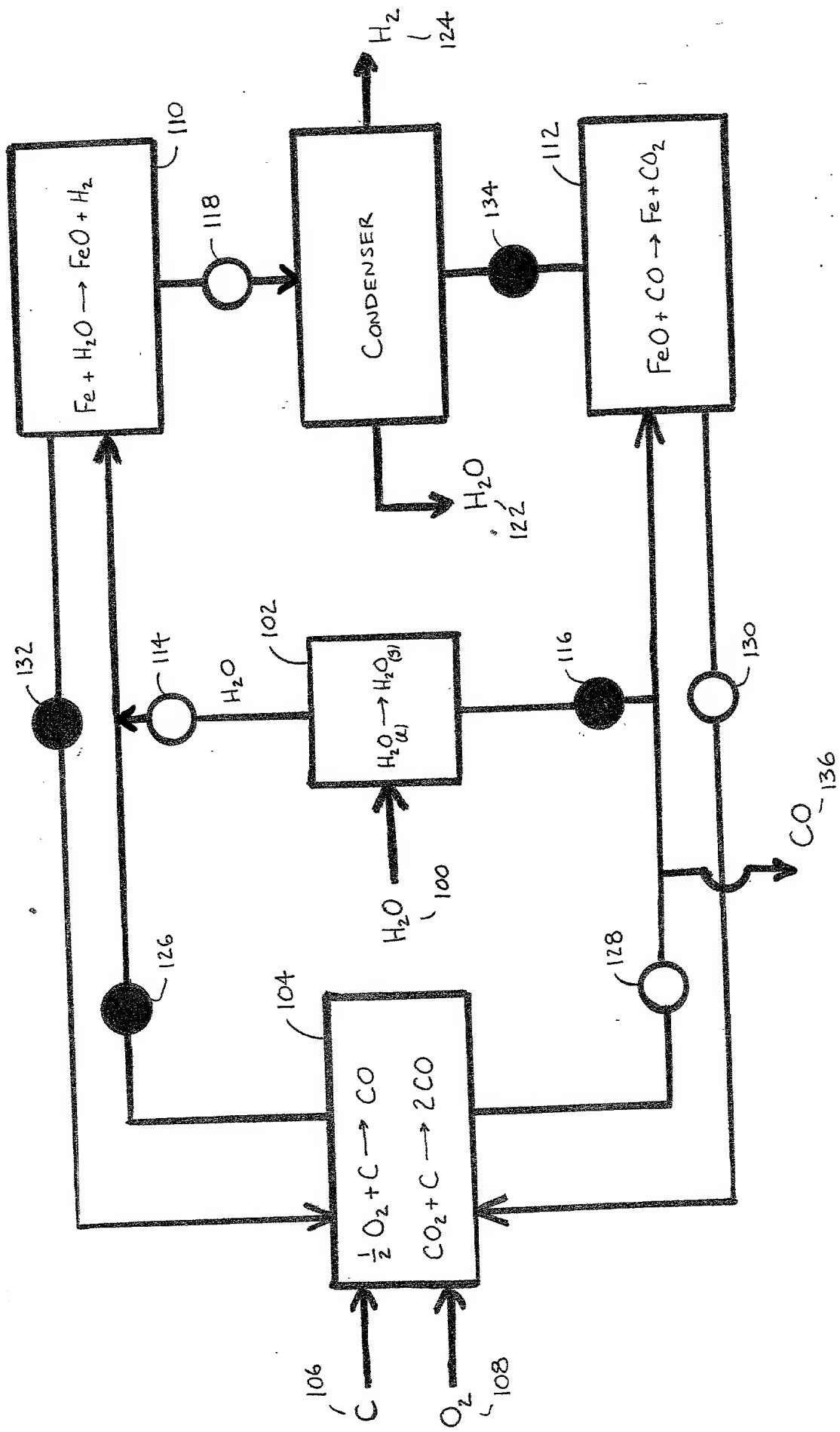


Fig. 1

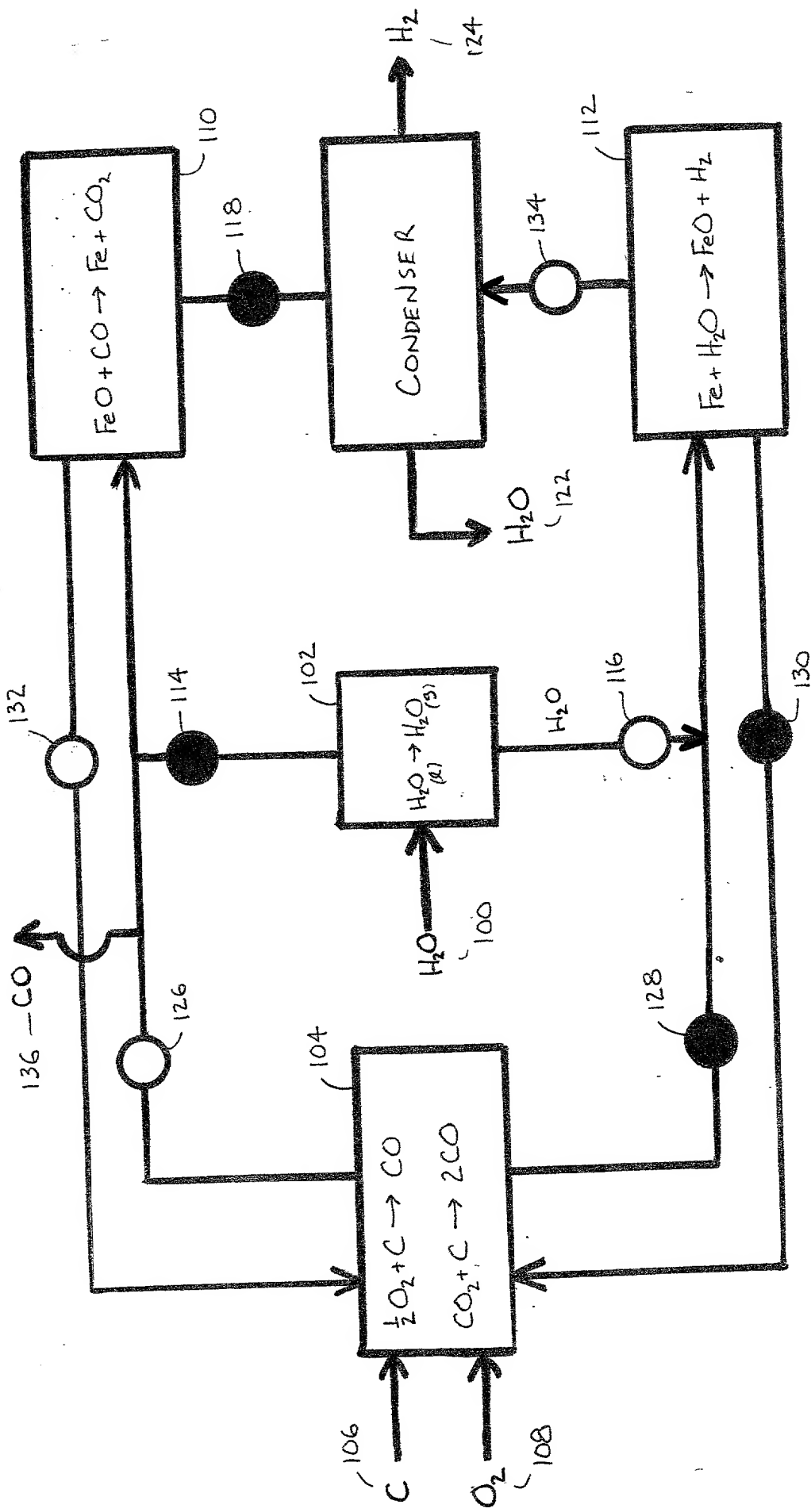


Fig. 2

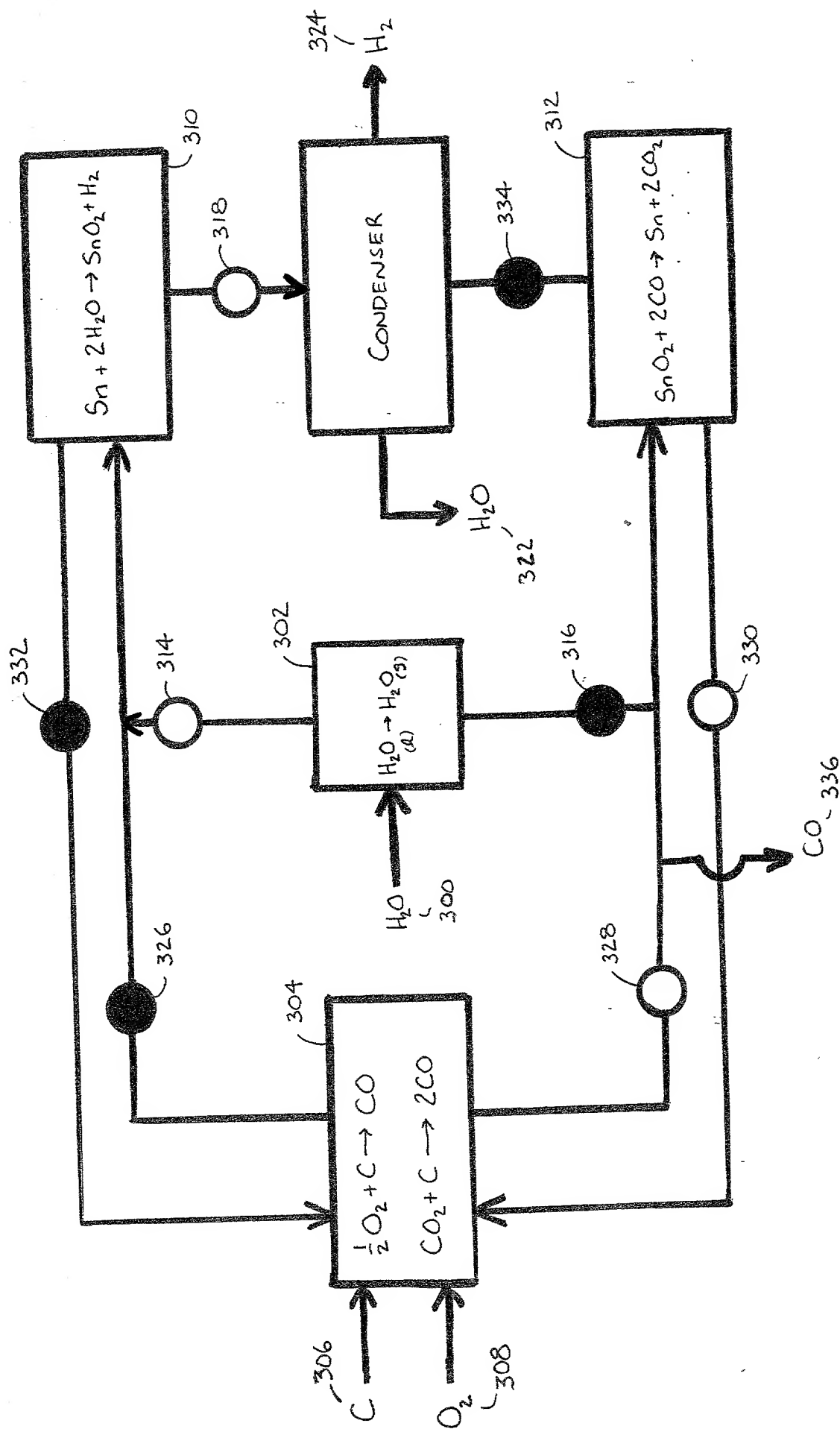


Fig. 3

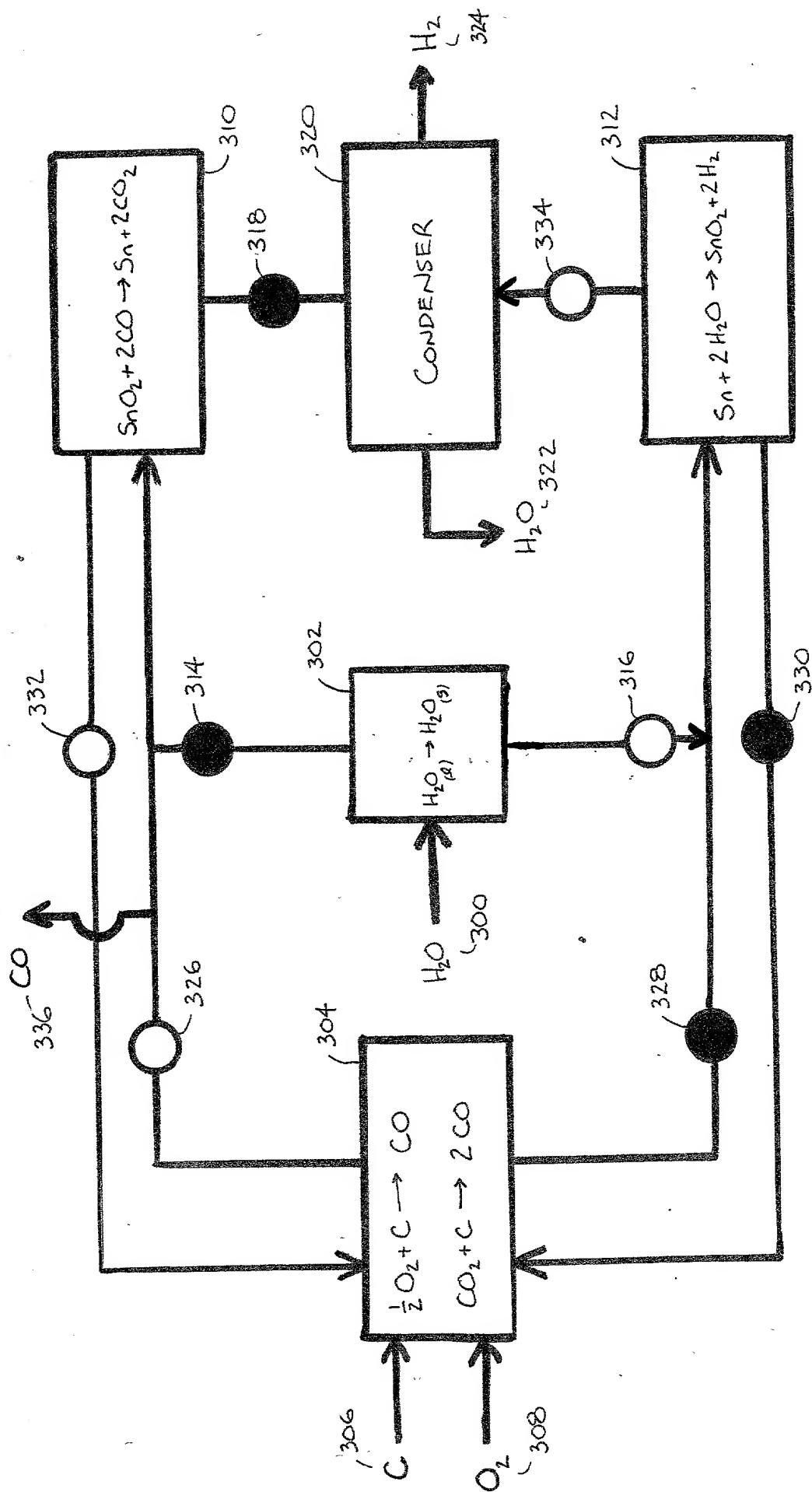


Fig. 4

FIG. 5 is a schematic diagram of a process for the production of hydrogen gas from a feedstock, in accordance with the present invention. The process includes a feedstock input to a hydrogeneration unit 540, which produces hydrogen gas (H₂) and a stream of inorganics and inert materials. The hydrogen gas is fed to a CO generation unit 504, which also receives carbon (C) and oxygen (O₂) inputs. The CO generation unit 504 produces a CO stream, which is fed to a metal oxide reduction unit 512. The metal oxide reduction unit 512 produces a CO₂ stream and a stream of inorganics and inert materials. The CO₂ stream is fed to a steam reduction unit 510, which produces a steam stream. The steam stream is fed to a boiler 502, which produces a hot water stream. The hot water stream is fed to a heat exchanger 532, which preheats the feedstock before it enters the hydrogeneration unit 540. The heat exchanger 532 also receives a cooling water stream from a condenser 520. The condenser 520 receives a stream of H₂O and CH₄ from the hydrogeneration unit 540 and produces a waste water stream. The condenser 520 is connected to a scrubber 542, which receives a caustic solution and produces a CH₄ stream. The scrubber 542 is connected to the hydrogeneration unit 540. The hydrogeneration unit 540 is also connected to a CO generation unit 504. The CO generation unit 504 is connected to a metal oxide reduction unit 512. The metal oxide reduction unit 512 is connected to a steam reduction unit 510. The steam reduction unit 510 is connected to a boiler 502. The boiler 502 is connected to a heat exchanger 532. The heat exchanger 532 is connected to a condenser 520. The condenser 520 is connected to a scrubber 542. The scrubber 542 is connected to the hydrogeneration unit 540. The hydrogeneration unit 540 is also connected to a CO generation unit 504. The CO generation unit 504 is connected to a metal oxide reduction unit 512. The metal oxide reduction unit 512 is connected to a steam reduction unit 510. The steam reduction unit 510 is connected to a boiler 502. The boiler 502 is connected to a heat exchanger 532. The heat exchanger 532 is connected to a condenser 520. The condenser 520 is connected to a scrubber 542. The scrubber 542 is connected to the hydrogeneration unit 540.

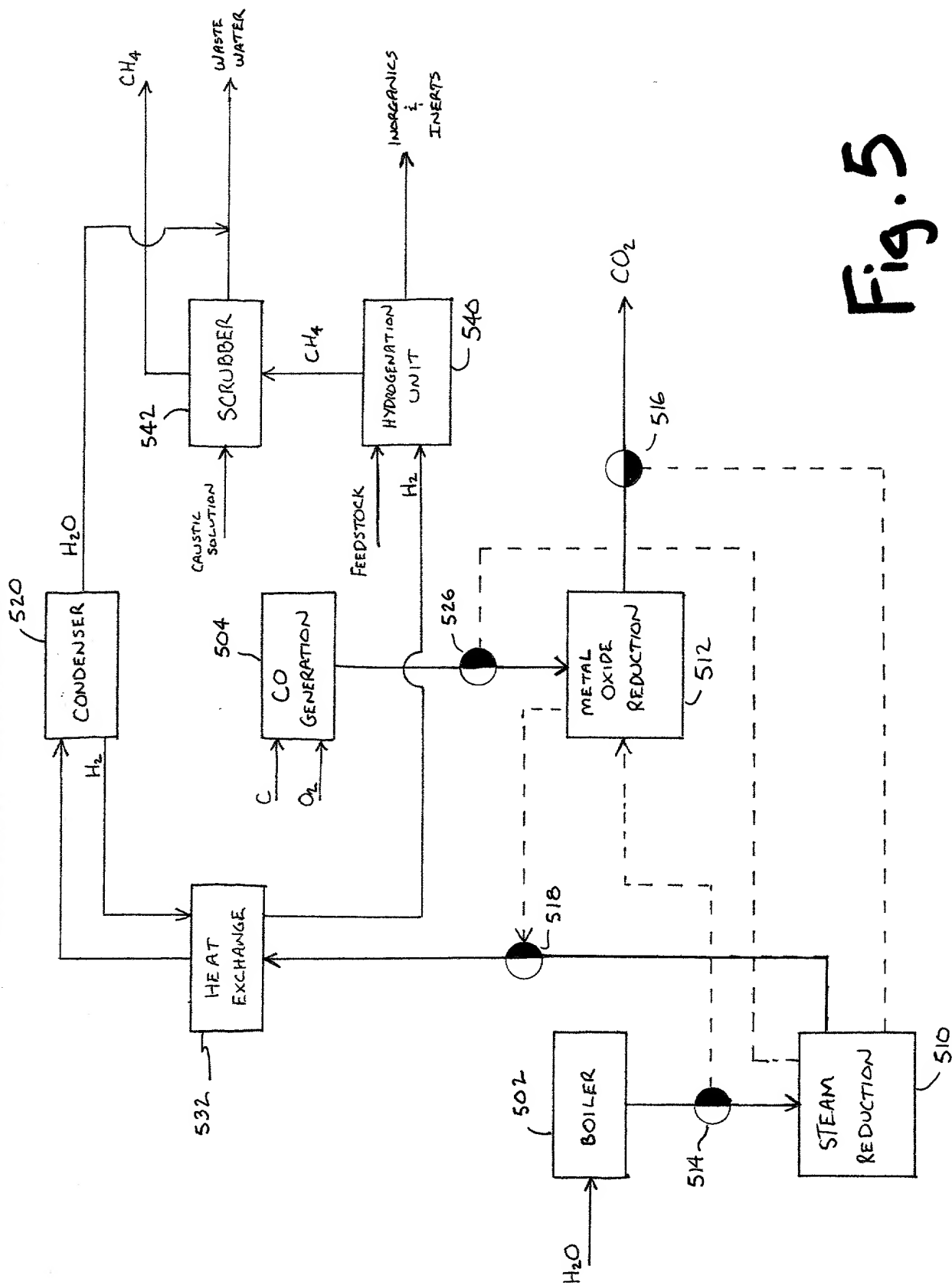


Fig. 5

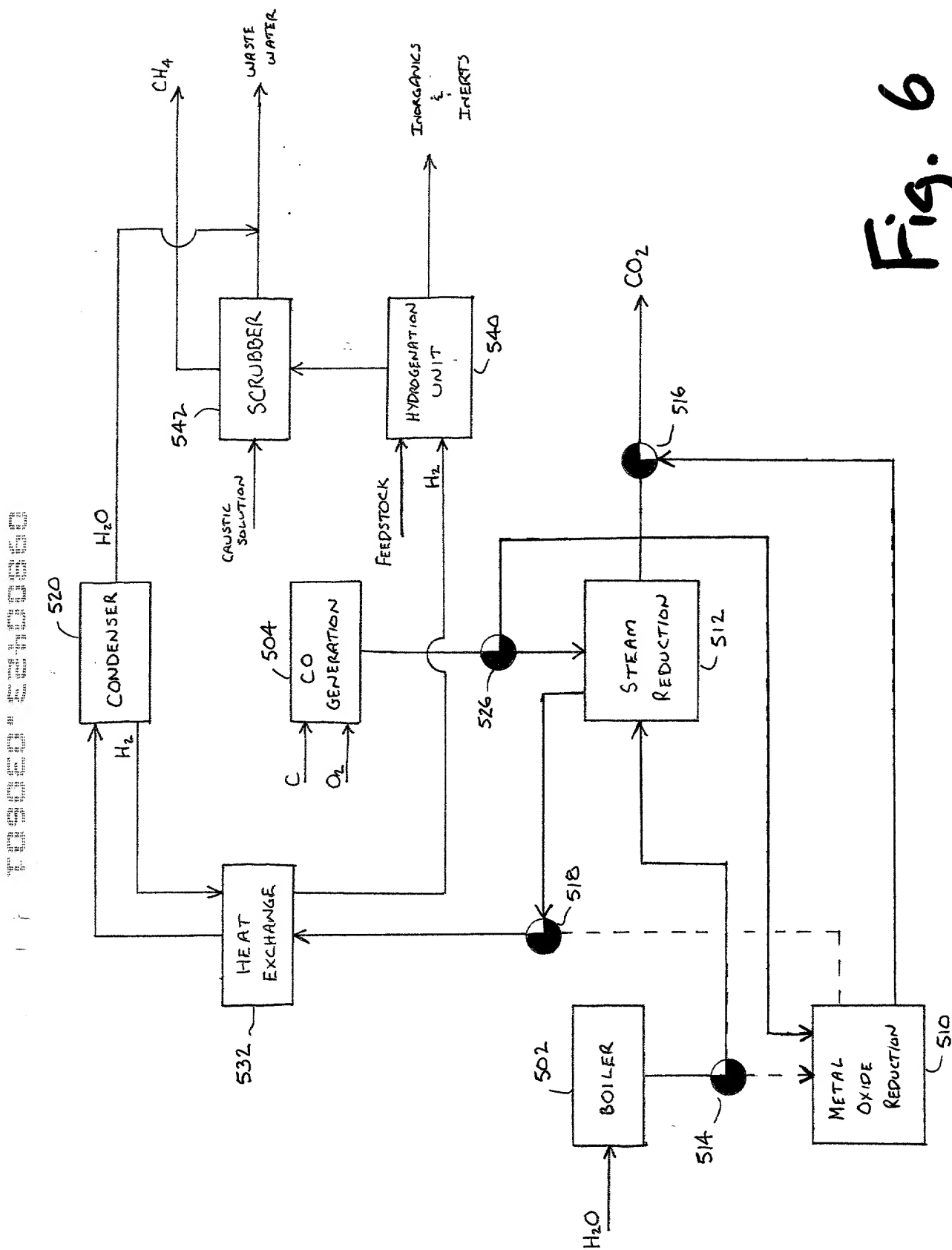


Fig. 6

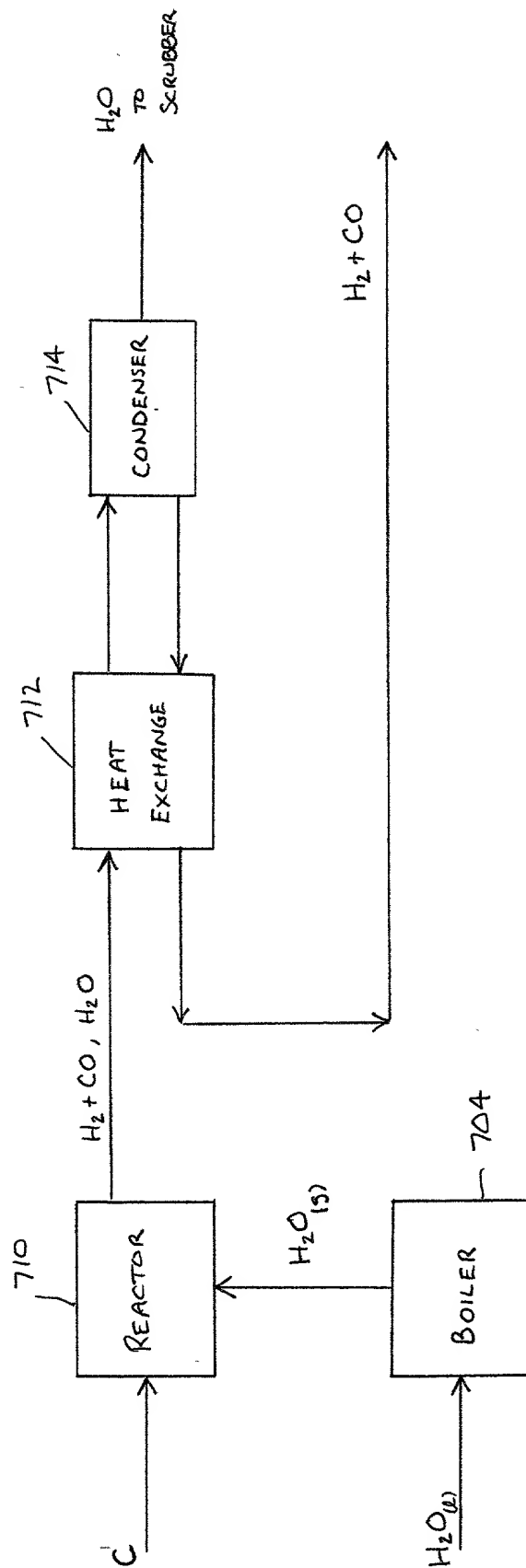


Fig. 7

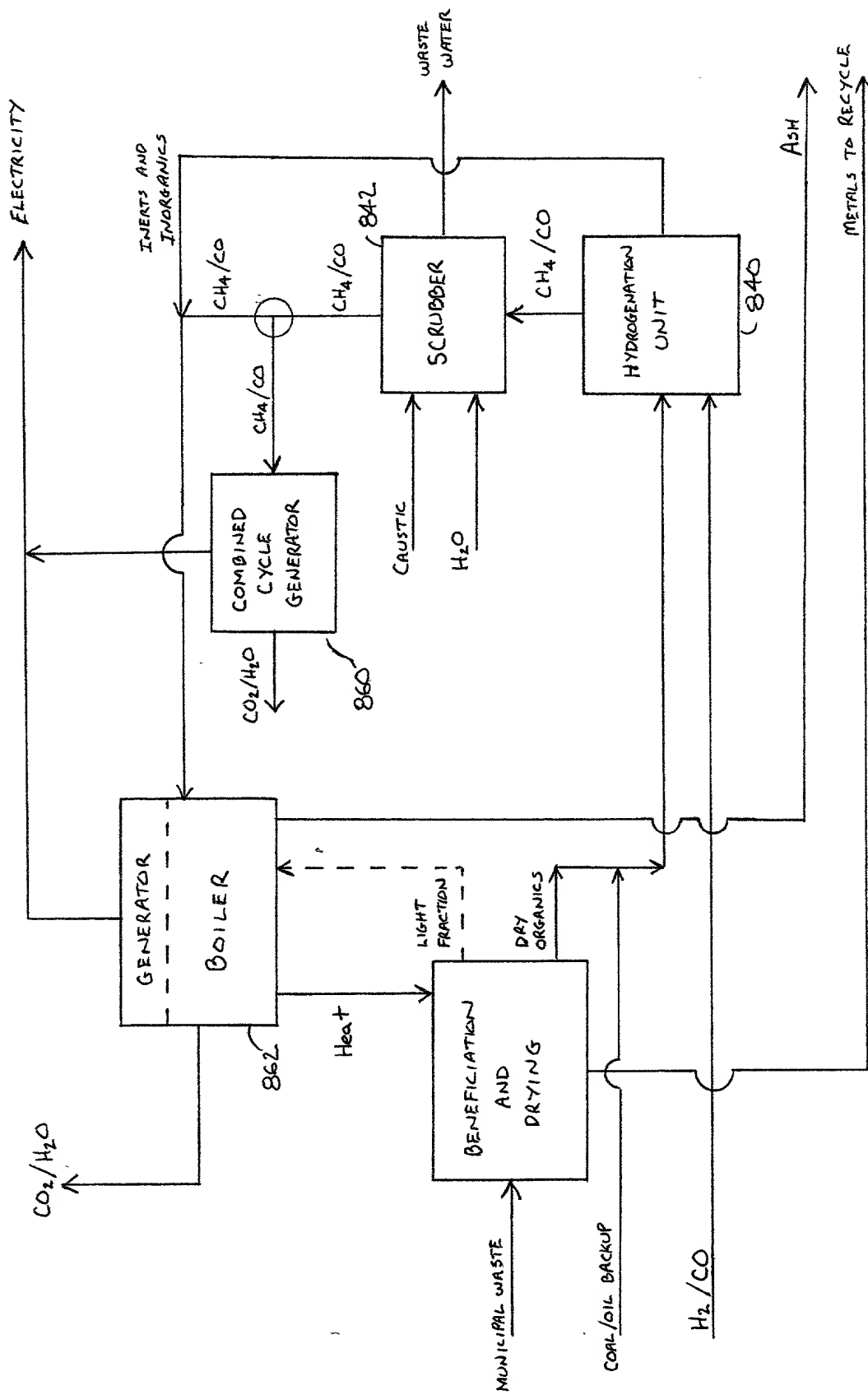


Fig. 8

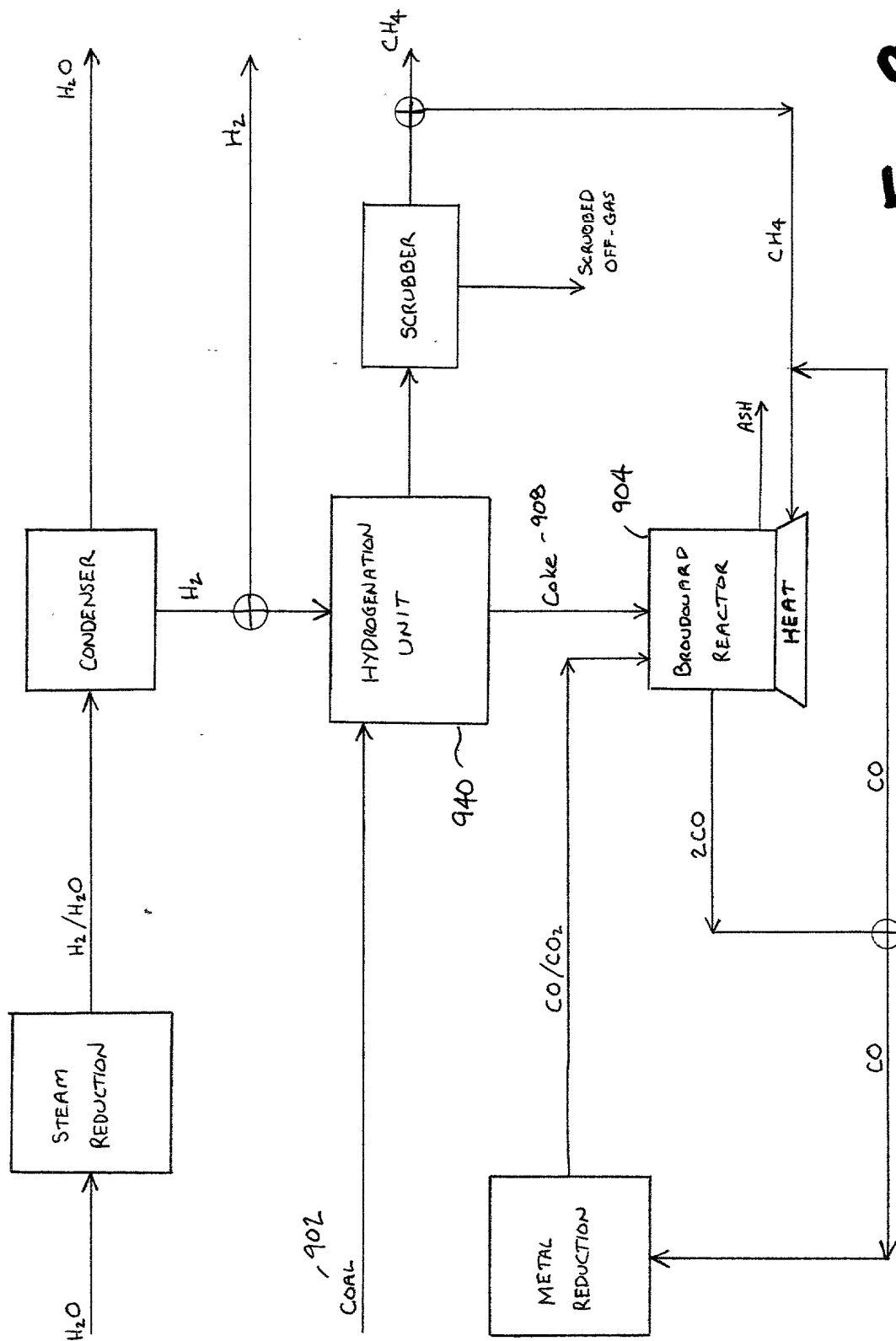


Fig. 9